Physical Activity Tool User Guide: PAT4LG, Version 1.0

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BACKGROUND

Physical inactivity is considered as one of the four main behavioural risk factors which increase the risk of several non-communicable diseases (NCDs) (World Health Organization, 2011). Increasing the level of physical activity in a population reduces the risk of NCDs and delays the progression of some diseases. This physical activity tool will enable the user to test the impact of different scenarios. For example, what are the health and cost impacts if all individuals in a given population meet the recommendations for physical activity?

Aims:

1. To project the incidence and prevalence of physical inactivity-related chronic diseases forward to 2035. The diseases included are **coronary heart disease (CHD), stroke, hypertension, type 2 diabetes, breast and colon cancers, depression** and **dementia**.
2. To estimate the costs avoided of these diseases to the National Health Service (NHS) following interventions which increase physical activity.

A reference list of the data included in the model is outlined in appendix 1.

INSTALLING THE PROGRAM

Step 0: Use a windows computer

Step 1: Double click on the zip file called S64paTool.zip

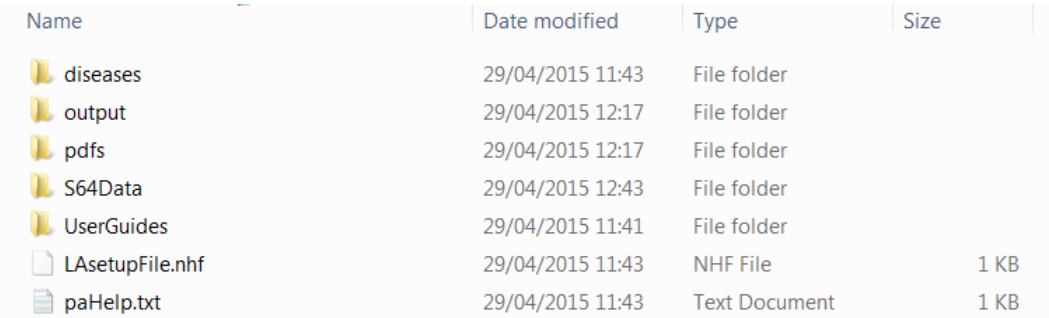
Step 2: unzip the S64paTool.zip folder and select 'extract all' (rf_pa_packfile.txt, UserGuides folder and S64Tool.exe) into a new folder

Step 3: Right click on the file S64Tool.exe and run as an administrator. A first window pops up saying where: "deploying to the file path where the user is using the tool". Click on "OK"

Step 4: The user will need accept the terms and conditions of the tool to be able to use it on their system

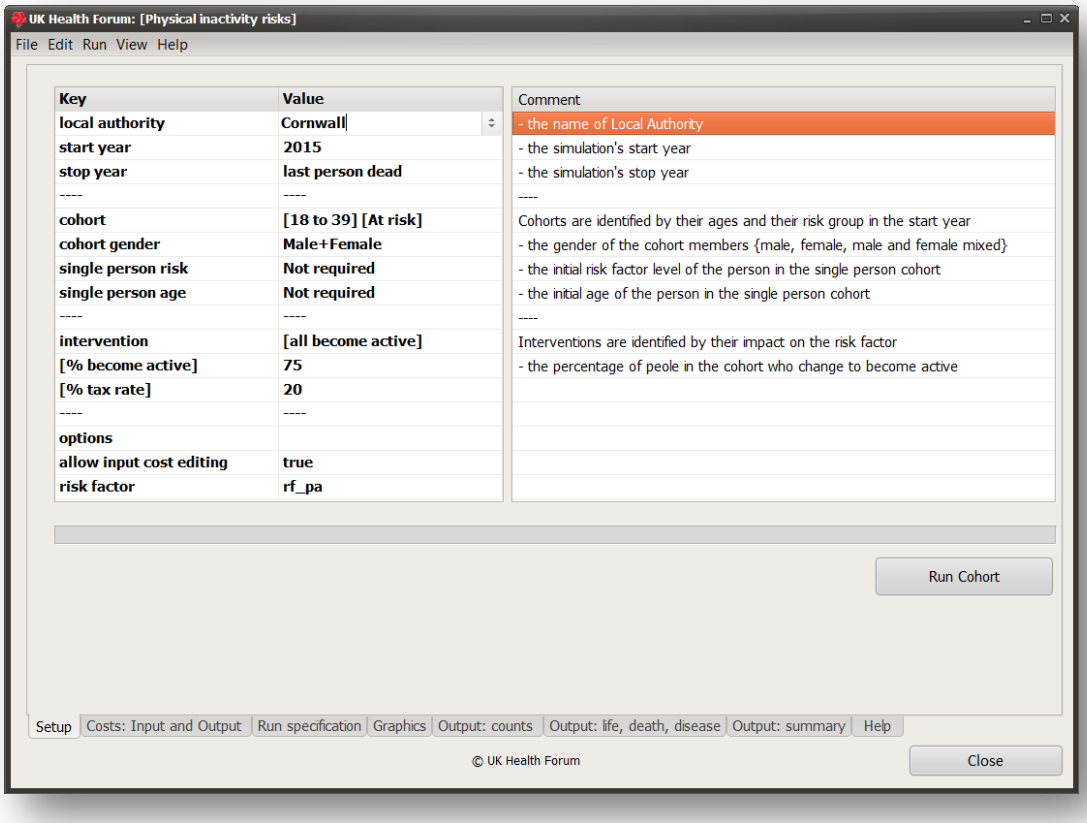
Step 5: Two events occur:

1. A file called LAsetup.nhf as well as five folders called: diseases, output, pdfs, S64Data and UserGuides are created



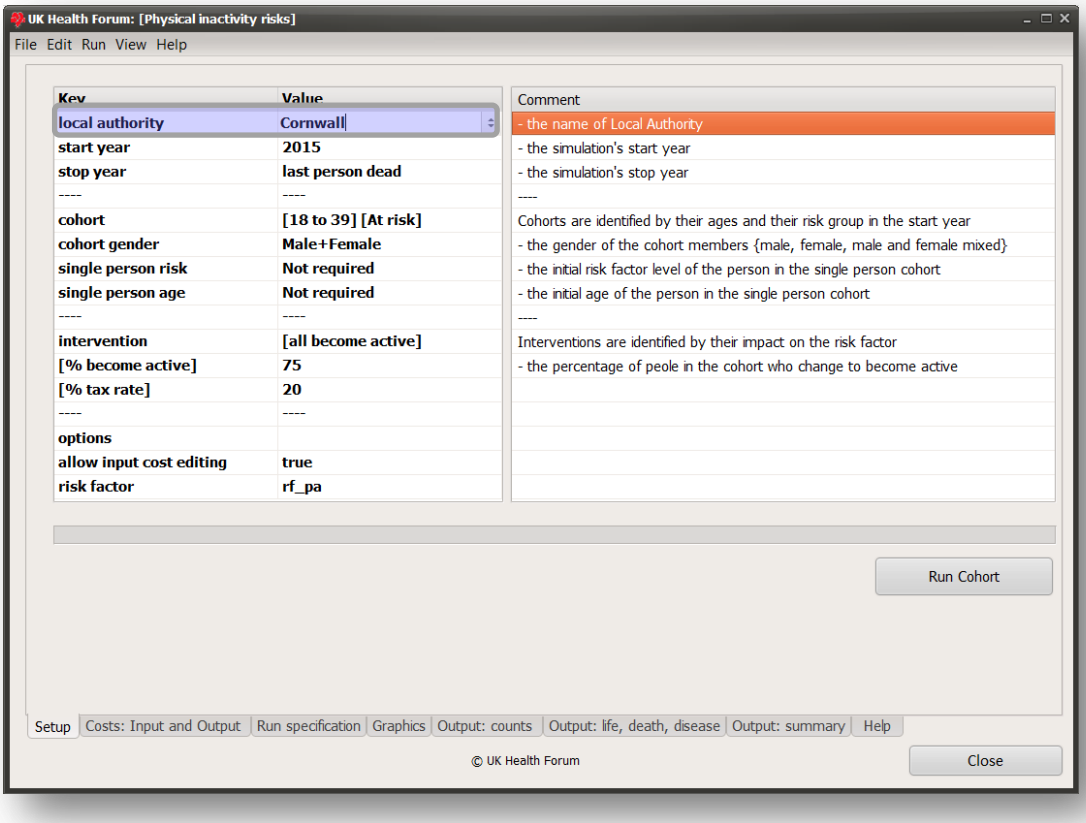
Name	Date modified	Type	Size
diseases	29/04/2015 11:43	File folder	
output	29/04/2015 12:17	File folder	
pdfs	29/04/2015 12:17	File folder	
S64Data	29/04/2015 12:43	File folder	
UserGuides	29/04/2015 11:41	File folder	
LAsetupFile.nhf	29/04/2015 11:43	NHF File	1 KB
paHelp.txt	29/04/2015 11:43	Text Document	1 KB

2. The following interface can be seen:

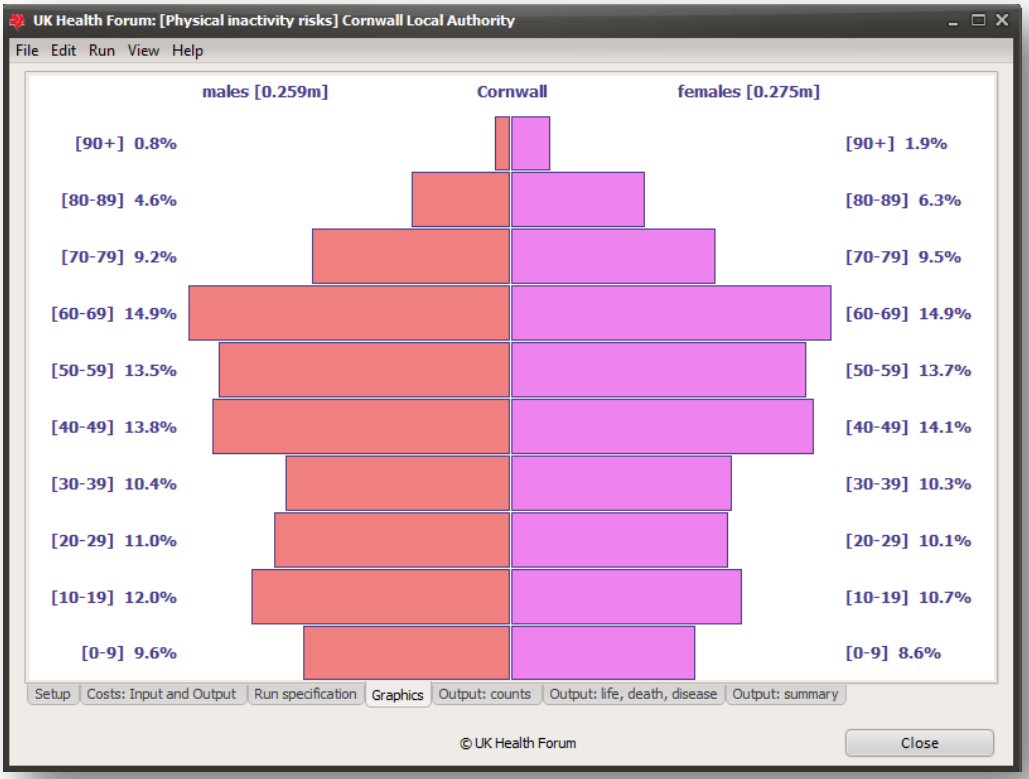


RUNNING THE SIMULATION

Step 1: On the main 'setup' dashboard use the drop down menu to select the local authority that you wish to run.

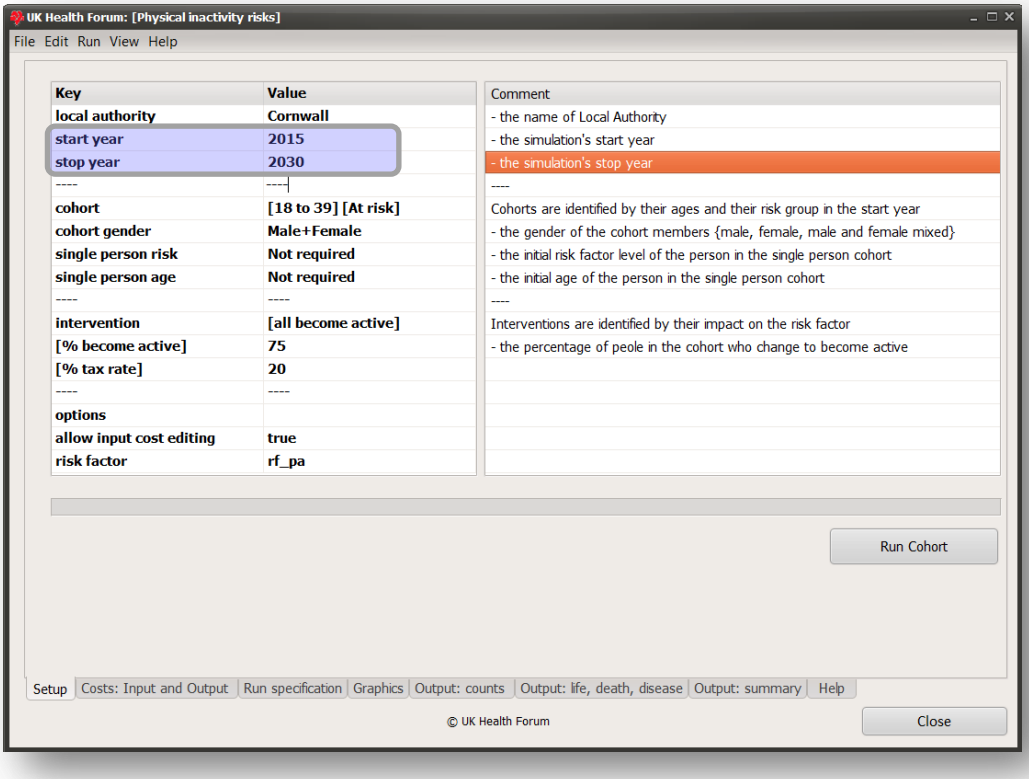


Note: Within the tool there is an option to display the age distribution of the population in your local authority of interest. To do this select 'view' in the main toolbar, and choose the desired 'population pyramid' to display. Cornwall is displayed as an example below:



This shows the total number of males and females in the local authority of interest and how they are distributed by age throughout the population.

Step 2: Select the start and stop year for the simulation using the drop down menu. For example, you can run the simulation starting in 2015 and end it in 2030.



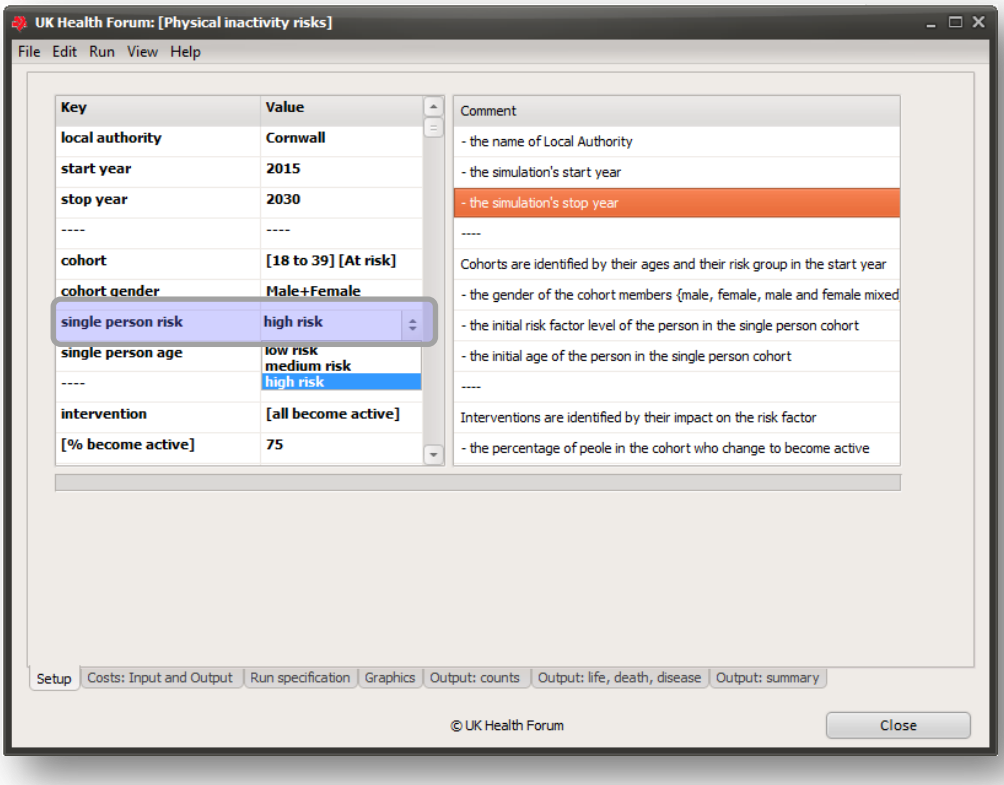
Step 3: Choose the cohort that you would like. There are two options:

a) Single person:

Select the age of the individual, and the risk of your interest:

1. Low risk, corresponding to physical activity levels greater than or equal to 150min/week
2. Medium risk, corresponding to physical activity levels between 30 and 150 min/week
3. High risk, corresponding to physical activity less than 30 min/week

You may wish to select a single person, rather than a cohort, in order to determine the risk of disease to an individual from reduced physical activity. For example, you may wish to analyse a range of trajectories of risk for a 20-year old male throughout his life. You can assign their level of risk e.g. low risk (>150min/week of physical activity).

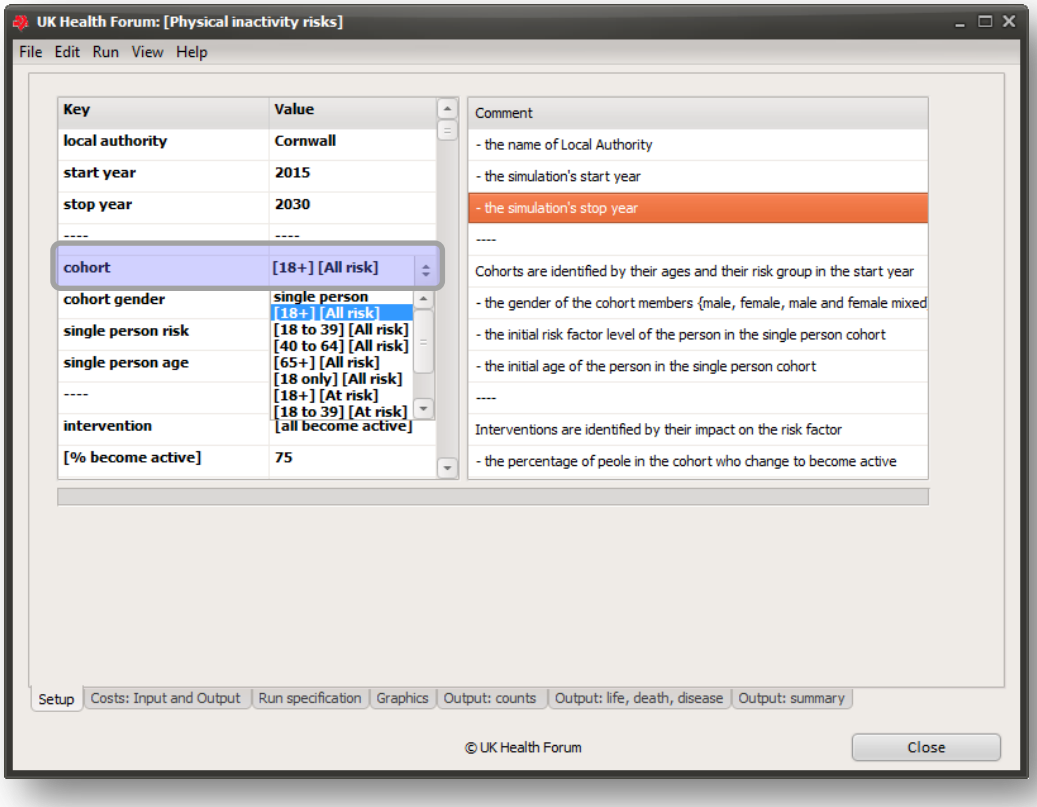


b) Cohort

Select the age boundaries of the cohort:

- **18+ (all risk)** – This refers to all adults in the local authority who are above the age of 18 years old, regardless of their risk (the distributions of the three levels of the risks, low, medium and high, are based on current distributions in local authorities)
- **18-39 (all risk)** - This refers to all adults in the local authority who are 18-39 years old, regardless of their risk
- **40-64 (all risk)** - This refers to all adults in the local authority who are 40-64 years old, regardless of their risk
- **65+ (all risk)** - This refers to all adults in the local authority who are 65 years or above, regardless of their risk
- **18+ (at risk)** - This refers to all adults in the local authority who are above the age of 18 years old and are 'at risk'. 'At risk' is assumed to be individuals who are inactive individuals (<150 minutes/week)
- **18-39 (at risk)** - This refers to all adults in the local authority who are 18-39 years old and are 'at risk'. 'At risk' is assumed to be individuals who are inactive individuals (<150 minutes/week)

- **40-64 (at risk)** - This refers to all adults in the local authority who are 40-64 years old and are 'at risk'. 'At risk' is assumed to be individuals who are inactive individuals (<150 minutes/week)
- **65+ (at risk)** - This refers to all adults in the local authority who are 65 years old or above and are 'at risk'. 'At risk' is assumed to be individuals who are inactive individuals (<150 minutes/week)


UK Health Forum: [Physical inactivity risks]
File Edit Run View Help
Key
Value
Comment
local authority
Cornwall
- the name of Local Authority
start year
2015
- the simulation's start year
stop year
2030
- the simulation's stop year
cohort
[18+] [All risk]
Cohorts are identified by their ages and their risk group in the start year
cohort gender
single person
- the gender of the cohort members {male, female, male and female mixed
single person risk
- the initial risk factor level of the person in the single person cohort
single person age
- the initial age of the person in the single person cohort
[18+] [All risk]
[18 to 39] [All risk]
[40 to 64] [All risk]
[65+] [All risk]
[18 only] [All risk]
[18+] [At risk]
[18 to 39] [At risk]
[all become active]
intervention
Interventions are identified by their impact on the risk factor
[% become active]
75
- the percentage of peole in the cohort who change to become active
Setup
Costs: Input and Output
Run specification
Graphics
Output: counts
Output: life, death, disease
Output: summary
© UK Health Forum
Close

Note: You can also specify the gender of the cohort (it is set to analyse both females and males by default, but you can specify the programme to only produce outputs for a particular gender). If a cohort is selected the single person attributes are automatically set to Not required.

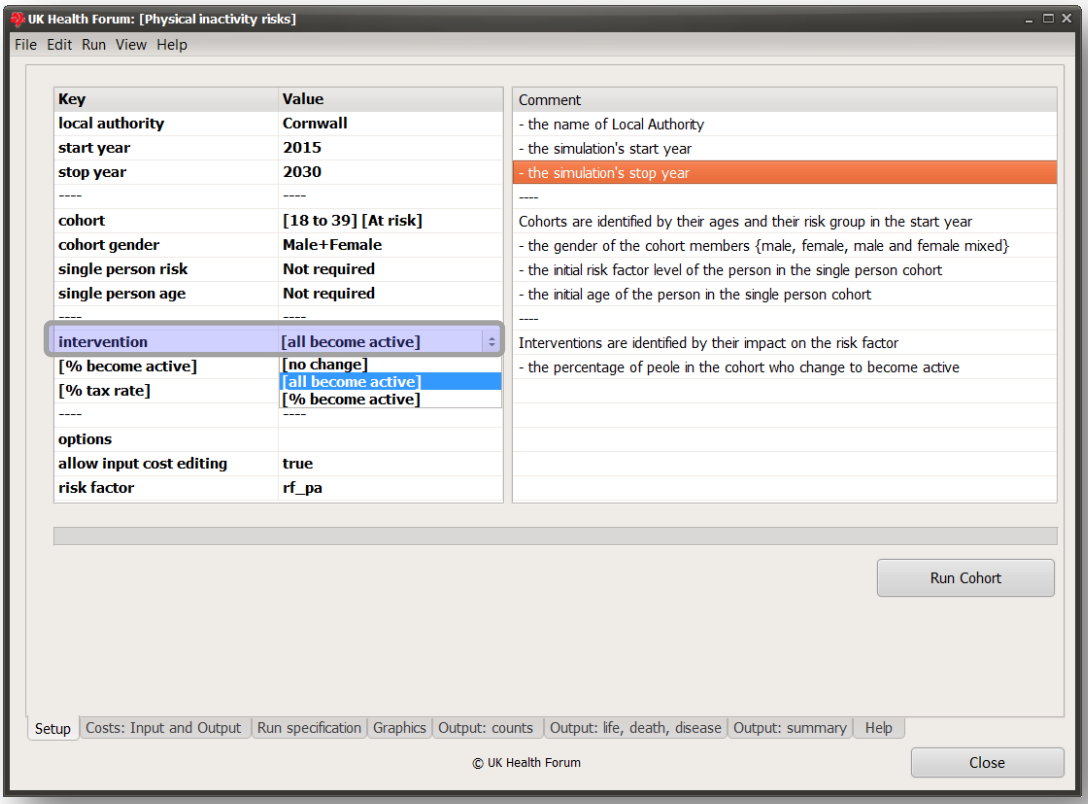
Step 4: Interventions

Select the intervention that you would like to test.

For physical activity you can select one of the following interventions:

1. 'No change' – trends continue as expected with no intervention i.e. baseline
2. 'All become active' – everybody in the population moves in to the active category (≥150 mins/week of physical activity on a weekly basis)

3. ‘% becomes active’ - A given percentage of the population becomes physically active e.g. 25% of inactive individuals move in to the active category (>150mins/wk)



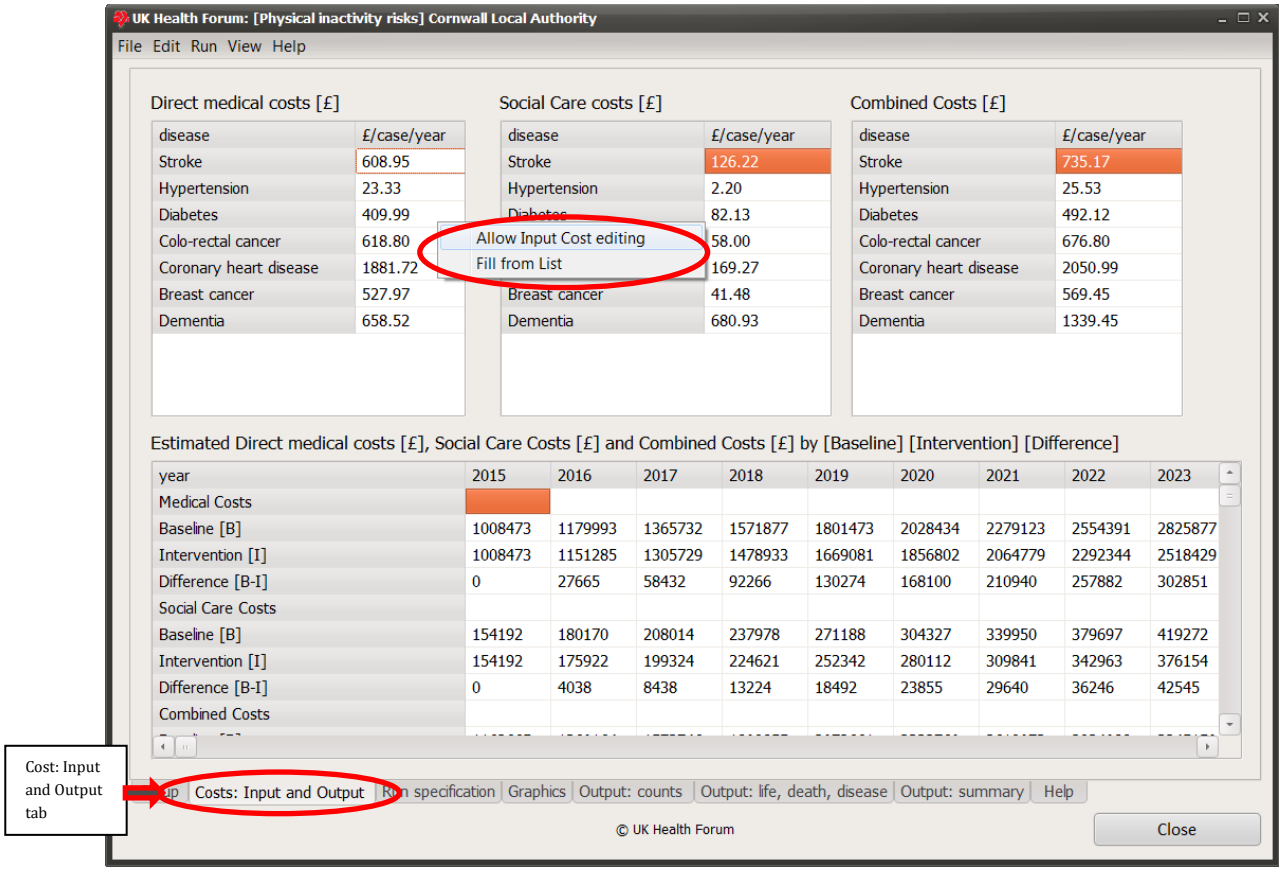
Step 5: allow input cost editing

Select ‘true’ if you would like to edit the cost inputs or ‘false’ if you would like them to remain as the input costs.

Key	Value
local authority	Cornwall
start year	2015
stop year	2030
----	----
cohort	[18 to 39] [At risk]
cohort gender	Male+Female
single person risk	Not required
single person age	Not required
----	----
intervention	[all become active]
[% become active]	75
[% tax rate]	20
----	----
options	
allow input cost editing	true
risk factor	rr_pa

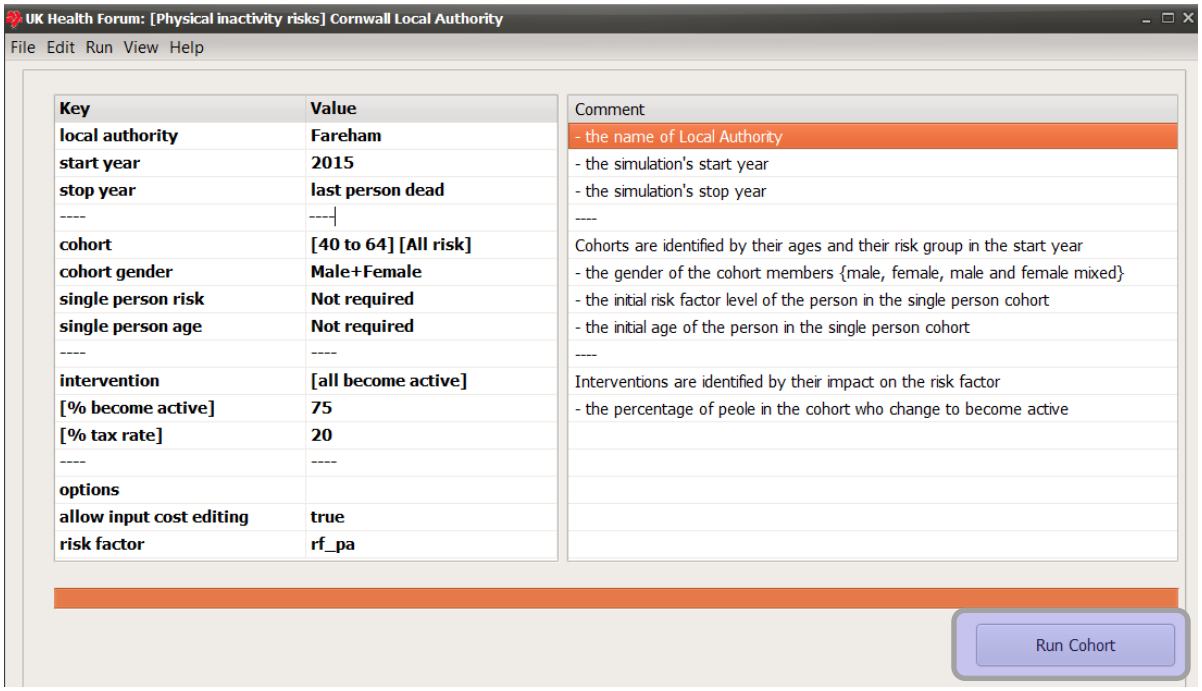
If you choose 'true', you should navigate to the 'costs: Input and Output' tab.

Right click on the cost that you would like to change and select 'Allow Input Cost editing'.

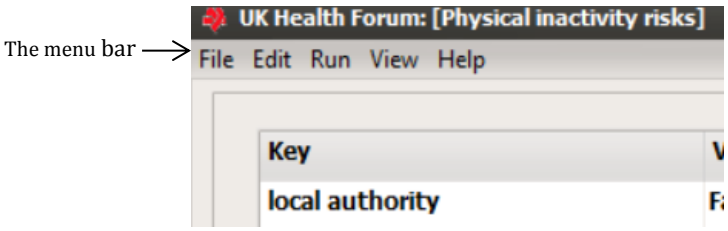

UK Health Forum: [Physical inactivity risks] Cornwall Local Authority
File Edit Run View Help
Direct medical costs [£]
Social Care costs [£]
Combined Costs [£]
Allow Input Cost editing
Fill from List
Estimated Direct medical costs [£], Social Care Costs [£] and Combined Costs [£] by [Baseline] [Intervention] [Difference]
Cost: Input and Output tab
Costs: Input and Output
Graphics
Output: counts
Output: life, death, disease
Output: summary
Help
© UK Health Forum
Close

Step 6: Run the simulation

Once you are happy with the set up, click 'run cohort' on the main setup page. This will run the simulation.


UK Health Forum: [Physical inactivity risks] Cornwall Local Authority
File Edit Run View Help
Key
Value
Comment
local authority
Fareham
- the name of Local Authority
start year
2015
- the simulation's start year
stop year
last person dead
- the simulation's stop year
cohort
[40 to 64] [All risk]
Cohorts are identified by their ages and their risk group in the start year
cohort gender
Male+Female
- the gender of the cohort members {male, female, male and female mixed}
single person risk
Not required
- the initial risk factor level of the person in the single person cohort
single person age
Not required
- the initial age of the person in the single person cohort
intervention
[all become active]
Interventions are identified by their impact on the risk factor
[% become active]
75
- the percentage of peole in the cohort who change to become active
[% tax rate]
20
options
allow input cost editing
true
risk factor
rf_pa
Run Cohort

Step 7: THE MENU BAR



There are a number of additional features that can be selected from the menu bar:

File/make data pack – this is restricted for the developer's access only.

Edit/setup - once you have run the simulation you can go back to the initial set up page by selecting 'edit/setup'

Edit/clear output - once you have run the simulation this will delete all of the outputs from any previous runs you have done

Run/initialise run - this gives you an overview of the initialisation components that you specified in the previous 4 steps above

Run/run cohort – this runs the simulation in the same way as the 'run cohort' button on the main setup screen

View/population tree – this allows you to view the population distribution of all ages, or specific age groups in the selected local authority

View/draw disease prevalence by year – selecting this with bring up a graph of the disease prevalence

View/draw cost savings by year

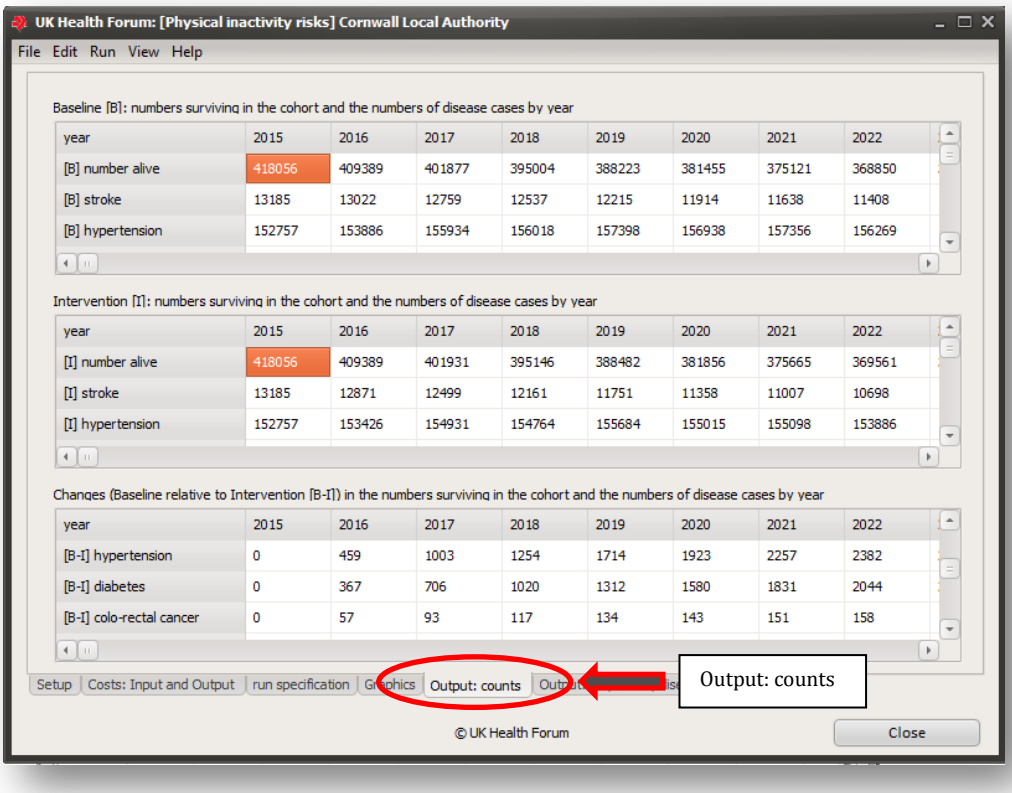
View/draw cumulative cost savings by year

Help – this contains the user guide, glossary of terms and the method used for deriving costs

OUTPUTS

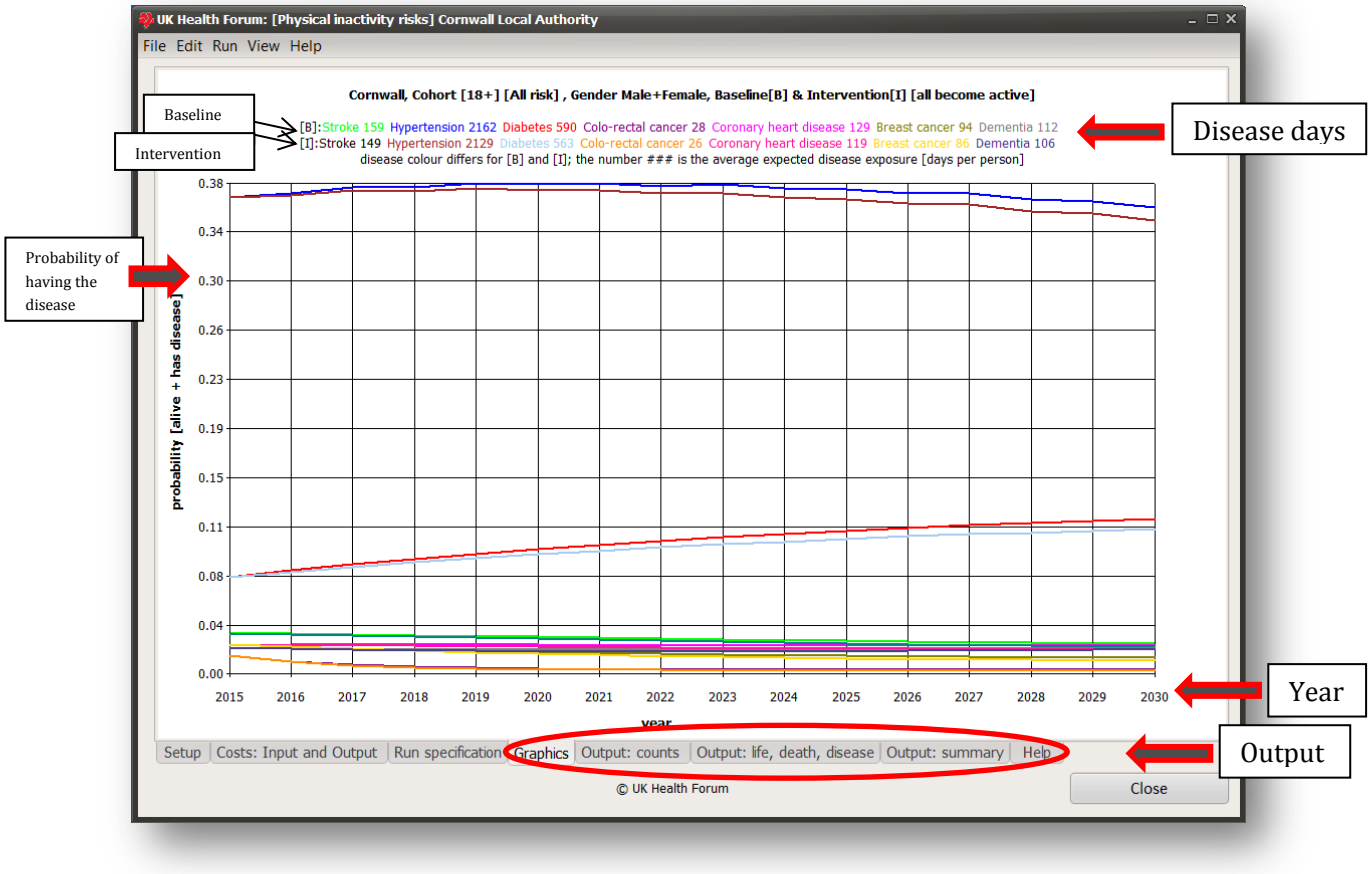
Once the tool has run, there should be output tabs along the bottom of the page:

1. 'Output: Counts' tab – click the tab at the bottom of the screen.
   The user should be able to see three tables:
   - 'Baseline': The number of people surviving in the cohort and the number of disease cases by year
   - 'Intervention': The number of people surviving in the cohort and the number of disease cases by year
   - 'Changes': The changes in the numbers in the cohort and the numbers of disease cases by year. Right clicking on a specific disease in this table and selecting 'Draw Selected Disease [cases by year]' will enable the user to plot changes in this disease for each year of the model simulation.


UK Health Forum: [Physical inactivity risks] Cornwall Local Authority
File Edit Run View Help
Baseline [B]: numbers surviving in the cohort and the numbers of disease cases by year
year 2015 2016 2017 2018 2019 2020 2021 2022
[B] number alive 418056 409389 401877 395004 388223 381455 375121 368850
[B] stroke 13185 13022 12759 12537 12215 11914 11638 11408
[B] hypertension 152757 153886 155934 156018 157398 156938 157356 156269
Intervention [I]: numbers surviving in the cohort and the numbers of disease cases by year
year 2015 2016 2017 2018 2019 2020 2021 2022
[I] number alive 418056 409389 401931 395146 388482 381856 375665 369561
[I] stroke 13185 12871 12499 12161 11751 11358 11007 10698
[I] hypertension 152757 153426 154931 154764 155684 155015 155098 153886
Changes (Baseline relative to Intervention [B-I]) in the numbers surviving in the cohort and the numbers of disease cases by year
year 2015 2016 2017 2018 2019 2020 2021 2022
[B-I] hypertension 0 459 1003 1254 1714 1923 2257 2382
[B-I] diabetes 0 367 706 1020 1312 1580 1831 2044
[B-I] colo-rectal cancer 0 57 93 117 134 143 151 158
Setup
Costs: Input and Output
run specification
Output: counts
Output: counts
© UK Health Forum
Close

2. Graphics

This graph shows the year along the x-axis and the probability of being alive and having a disease on the y-axis. The diseases are listed at the top of the graph with average number of expected disease days per person throughout their life.


UK Health Forum: [Physical inactivity risks] Cornwall Local Authority
File Edit Run View Help
Cornwall, Cohort [18+] [All risk] , Gender Male+Female, Baseline[B] & Intervention[I] [all become active]
Baseline
Intervention
[B]:Stroke 159 Hypertension 2162 Diabetes 590 Colo-rectal cancer 28 Coronary heart disease 129 Breast cancer 94 Dementia 112
[I]:Stroke 149 Hypertension 2129 Diabetes 563 Colo-rectal cancer 26 Coronary heart disease 119 Breast cancer 86 Dementia 106
disease colour differs for [B] and [I]; the number ### is the average expected disease exposure [days per person]
Disease days
Probability of having the disease
probability [alive + has disease]
0.38
0.34
0.30
0.26
0.23
0.19
0.15
0.11
0.08
0.04
0.00
2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030
year
Year
Setup Costs: Input and Output Run specification Graphics Output: counts Output: life, death, disease Output: summary Help
Output
© UK Health Forum
Close

How to interpret the graph:

At **baseline**, the average number of disease exposure days for hypertension is 2162 and diabetes is 590 per person.

Following the **intervention**, (all become active), the average number of disease exposure days for hypertension is 2129 and diabetes is 563.

You can 'right click on this graph':

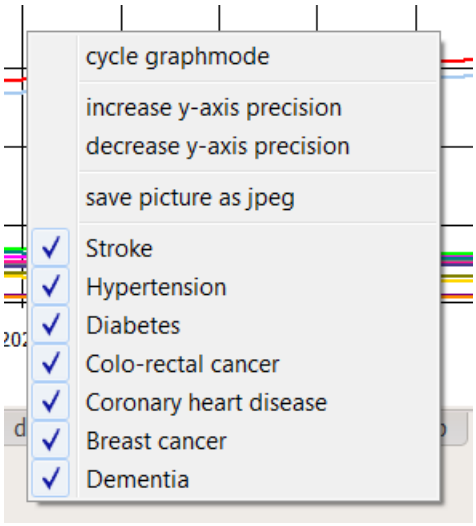
This allows you to:

- cycle graph mode – to cycle through different types of graphics

- increase or decrease the precision of the y-axis

- save the graph as a jpeg file to use the pictures in your reports

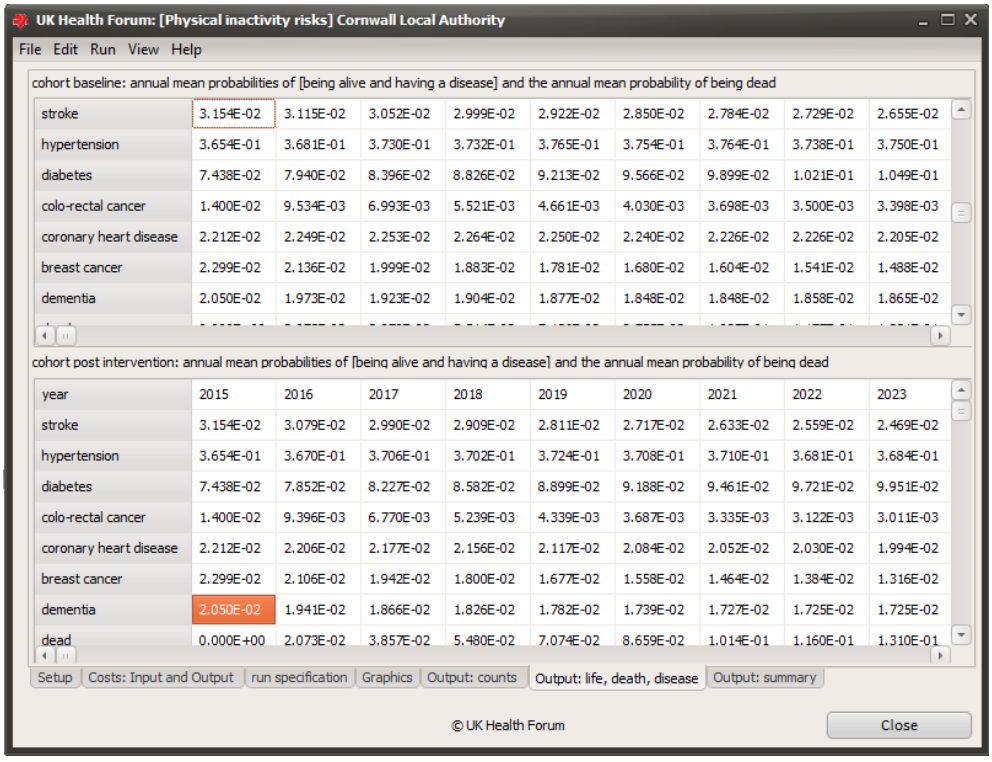
- take out diseases so that you can view other diseases on a more readable scale.



3. Output: life, death, disease

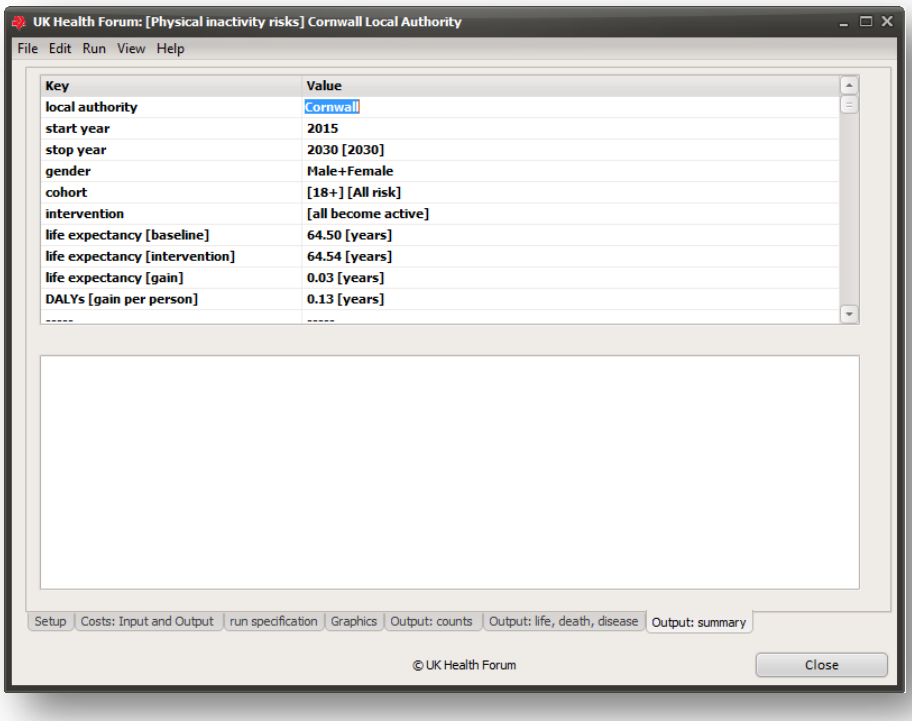
   The user should be able to see two tables:

   - 'Baseline cohort': The annual mean probability of being alive and to have a disease or to die
   - 'Cohort post intervention': The annual mean probability of being alive and to have a disease or to die



4. Output: summary

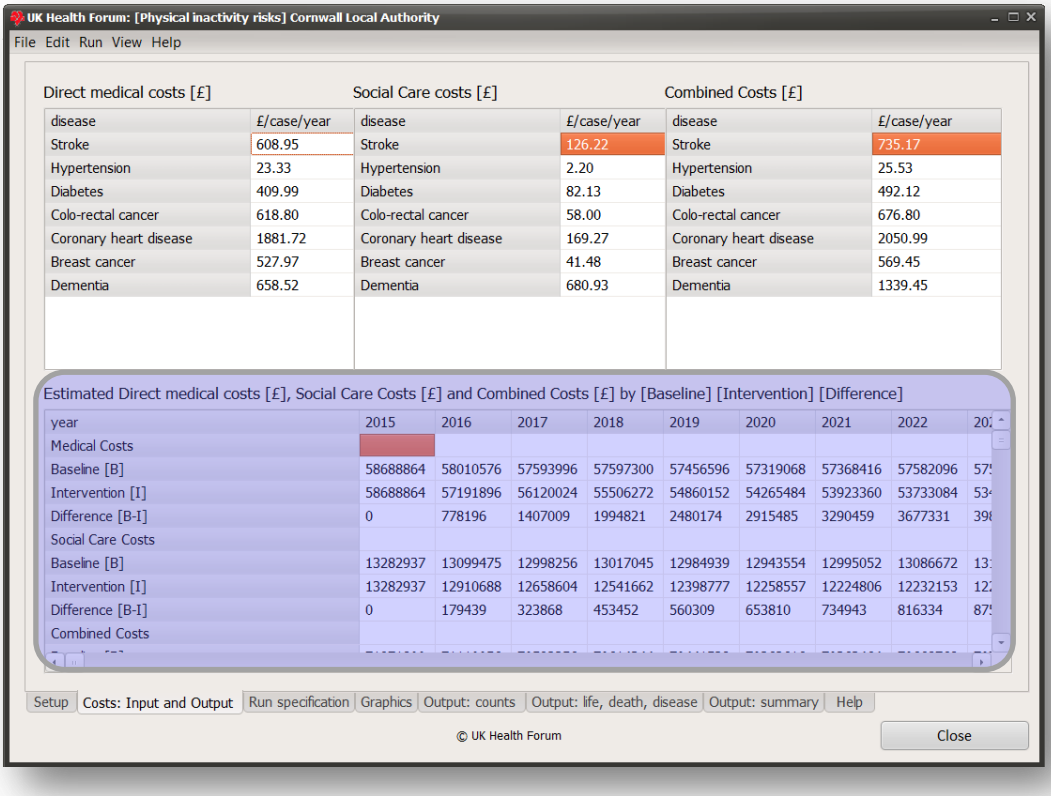
The user should be able to see a table with the summary of the run as well as data regarding life expectancies as well as DALYs[1] (gain per person).



5. Costs: Input and Output

The programme uses NHS programme budget costs for each disease, adjusted for local authority population. However, the user can change these costs if they would like.

[1]DALYs are disability adjusted life years. One DALY is one lost year of "healthy" life. The sum of these DALYs across the population, or the burden of disease, can be thought of as a measurement of the gap between current health status and an ideal health situation where the entire population lives to an advanced age, free of disease and disability.


UK Health Forum: [Physical inactivity risks] Cornwall Local Authority
File Edit Run View Help
Direct medical costs [£]
Social Care costs [£]
Combined Costs [£]
disease £/case/year
Stroke 608.95
Hypertension 23.33
Diabetes 409.99
Colo-rectal cancer 618.80
Coronary heart disease 1881.72
Breast cancer 527.97
Dementia 658.52
disease £/case/year
Stroke 126.22
Hypertension 2.20
Diabetes 82.13
Colo-rectal cancer 58.00
Coronary heart disease 169.27
Breast cancer 41.48
Dementia 680.93
disease £/case/year
Stroke 735.17
Hypertension 25.53
Diabetes 492.12
Colo-rectal cancer 676.80
Coronary heart disease 2050.99
Breast cancer 569.45
Dementia 1339.45
Estimated Direct medical costs [£], Social Care Costs [£] and Combined Costs [£] by [Baseline] [Intervention] [Difference]
year 2015 2016 2017 2018 2019 2020 2021 2022
Medical Costs
Baseline [B] 58688864 58010576 57593996 57597300 57456596 57319068 57368416 57582096
Intervention [I] 58688864 57191896 56120024 55506272 54860152 54265484 53923360 53733084
Difference [B-I] 0 778196 1407009 1994821 2480174 2915485 3290459 3677331
Social Care Costs
Baseline [B] 13282937 13099475 12998256 13017045 12984939 12943554 12995052 13086672
Intervention [I] 13282937 12910688 12658604 12541662 12398777 12258557 12224806 12232153
Difference [B-I] 0 179439 323868 453452 560309 653810 734943 816334
Combined Costs
Setup
Costs: Input and Output
Run specification
Graphics
Output: counts
Output: life, death, disease
Output: summary
Help
© UK Health Forum
Close

All the outputs are saved in the output folder under the local authority and time and date of the run. The counts by year can be found in the text file called: BaseCounts.txt

The prevalence of the baseline scenario can be found in the text file called in BasePrev.txt

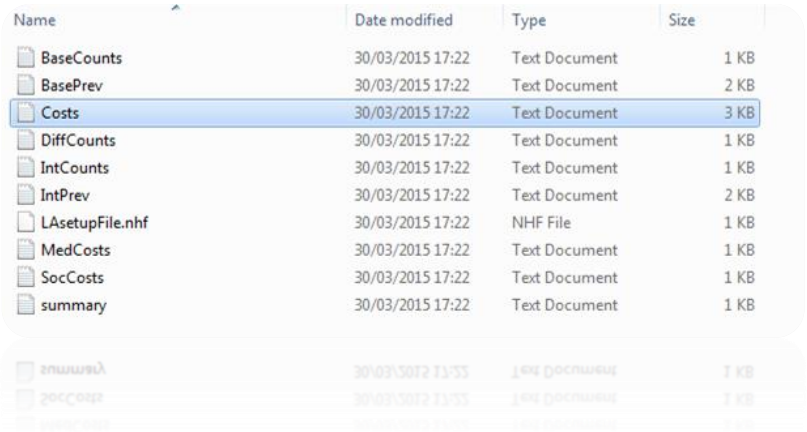
The costs for the baseline and intervention by year can be found in Costs.txt

The change in costs by year can be found in DiffCounts.txt

The intervention costs can be found in IntCounts.txt

The prevalence for the intervention can be found in IntPrev.txt

The summary of the run (DALYs, life expectancy etc.) can be found in summary.txt



Name	Date modified	Type	Size
BaseCounts	30/03/2015 17:22	Text Document	1 KB
BasePrev	30/03/2015 17:22	Text Document	2 KB
Costs	30/03/2015 17:22	Text Document	3 KB
DiffCounts	30/03/2015 17:22	Text Document	1 KB
IntCounts	30/03/2015 17:22	Text Document	1 KB
IntPrev	30/03/2015 17:22	Text Document	2 KB
LAsetupFile.nhf	30/03/2015 17:22	NHF File	1 KB
MedCosts	30/03/2015 17:22	Text Document	1 KB
SocCosts	30/03/2015 17:22	Text Document	1 KB
summary	30/03/2015 17:22	Text Document	1 KB

REFERENCES

World Health Organization. (2011). Global status report on noncommunicable diseases 2010. Retrieved from http://whqlibdoc.who.int/publications/2011/9789240686458_eng.pdf

Appendix 1. Data references

Diseases	Incidence	Prevalence	Survival	Mortality	Health care Costs	Social care costs	Utility weights	RR physical activity
Depression	computed from prevalence	Adult Psychiatric Morbidity Survey, 2007	non-fatal	non-fatal	NHS England, 2013	NHS England, 2013	Hunter et al; 2013.	US Surgeon General Report, 2008
Dementia	Rait et al, 2010	Alzheimer's Society, 2014	computed from prev	ONS 2013	NHS England, 2013	NHS England, 2013	Sullivan et al, 2011	Blondell et al, 2014
CHD	Smolina et al, 2013	BHF 2014	computed from prev	ONS 2013	NHS England, 2013	NHS England, 2013	Sullivan et al, 2011	Li and Siegrist, 2012
Diabetes	Personal communication Dr. Craig Currie	IDF 2012	non-fatal	non-fatal	NHS England, 2013	NHS England, 2013	Sullivan et al, 2011	Jeon et al, 2007
Stroke	BHF 2009	BHF 2014	computed from prev	ONS 2013	NHS England, 2013	NHS England, 2013	Sullivan et al, 2011	Li and Siegrist, 2012
Hypertension	computed from prevalence	BHF 2012	non-fatal	non-fatal	NHS England, 2013	NHS England, 2013	Sullivan et al, 2011	Huai et al, 2013
Breast cancer	CRUK 2011		ONS 2012	CRUK 2012	NHS England, 2013	NHS England, 2013	Sullivan et al, 2011	Lee et al, 2012
Colorectal cancer	CRUK 2011		ONS 2012	CRUK 2012	NHS England, 2013	NHS England, 2013	Sullivan et al, 2011	Wolin et al, 2011

Appendix 2. Glossary of terms

Baseline – This refers to the 'steady state' of the risk factor. A scenario where no intervention occurs and trends continue unabated.
Data pack - This is a single file which contains all of the disease and population statistics required by the tool.
Disease exposure – this refers to the number of days per person that an individual has a disease. For example, 500 diabetes days refers to the number of days an individual is alive and lives with a disease
Distribution –the frequency of various outcomes in a sample population. The frequency or count of the occurrences of values within a particular group or interval, and in this way, the table summarizes the distribution of values in the sample.
Incidence – the occurrence of *new* cases of the disease – not to be confused with prevalence.
Prevalence – this is the total number of cases of a disease in a particular population. This indicates how widespread the disease is.
Probability – this is the chance of a disease occurring. Probability always lies within 0 and 1.
Simulation – the imitation of a real-world process or system over time, in this case the simulation of a virtual local authority population

Appendix 3. How are costs calculated?

Cost data were taken from National Health Service programme Budget costs (NHS Networks, 2014). Both direct health care costs and NHS social care costs were extracted for each disease. When only total costs for a disease *group* were available (e.g. total cost of upper-gastro-intestinal cancers) the cost of an individual disease within that group was calculated as a proportion of the total costs based on Hospital Episode Statistics (Health and Social Care Information Centre, 2014a; Health and Social Care Information Centre, 2014b). It was assumed that the costs for each disease in that group are equal. For example, for upper gastro-intestinal cancers we included oesophageal, stomach, small bowel, pancreas, liver and biliary cancer. To find out the costs of oesophageal cancer we divided incidence of oesophageal cancer by total hospital episodes of gastro-intestinal cancers and then multiplied the output by the total expenditure on gastro-intestinal cancers.

For hypertension, outpatient cases only were used to estimate the ratio for the NHS budget costs. Inpatient data were excluded since hypertension patients are most likely to be seen within primary care and outpatient settings.

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Input costs – based on NHS programme budget costs

	Costs in £billion	
	NHS	Social care
Hypertension	0.3294	0.0311
Coronary heart disease	1.4635	0.1343
Stroke	0.6757	0.1434
Diabetes	1.151	0.2306
Breast cancer	0.4477	0.0352
Colorectal cancer	0.3168	0.0297
Larynx cancer	0.0179	0.0038
Liver cancer	0.0265	0.0027
Oesophageal cancer	0.0518	0.0054
Oral and pharynx cancer	0.0569	0.0121
Liver disease/liver cirrhosis	0.0716	0.0037

Following the simulation run, the programme simply scales the aggregated individual disease costs according to the relative disease prevalence in years after the start year.
In any year, the total healthcare cost for the disease D is denoted $C_D(year)$. If the prevalence of the disease is denoted $P_D(year)$ we assume a simple relationship between the two of the form

$$C_D\left(year\right) = \kappa P_D\left(year\right)$$

for some constant κ.

Since these costs are based on NHS programme budget costs for the whole of the country, the costs are multiplied by a ratio of the Local authority population relative to the English population.

For example, to derive the costs for Ealing, we
1. calculated a ratio for the Total Ealing population/Total England population:

Populations	Males	Females	Total	Ratio
England	26533969	27331848	53865817	
Ealing	169844	169470	339314	**0.006299**

2. multiplied this ratio by the total output costs following the simulation (these costs are based on total NHS costs for the country). Therefore the costs were scaled for the size of the local authority.